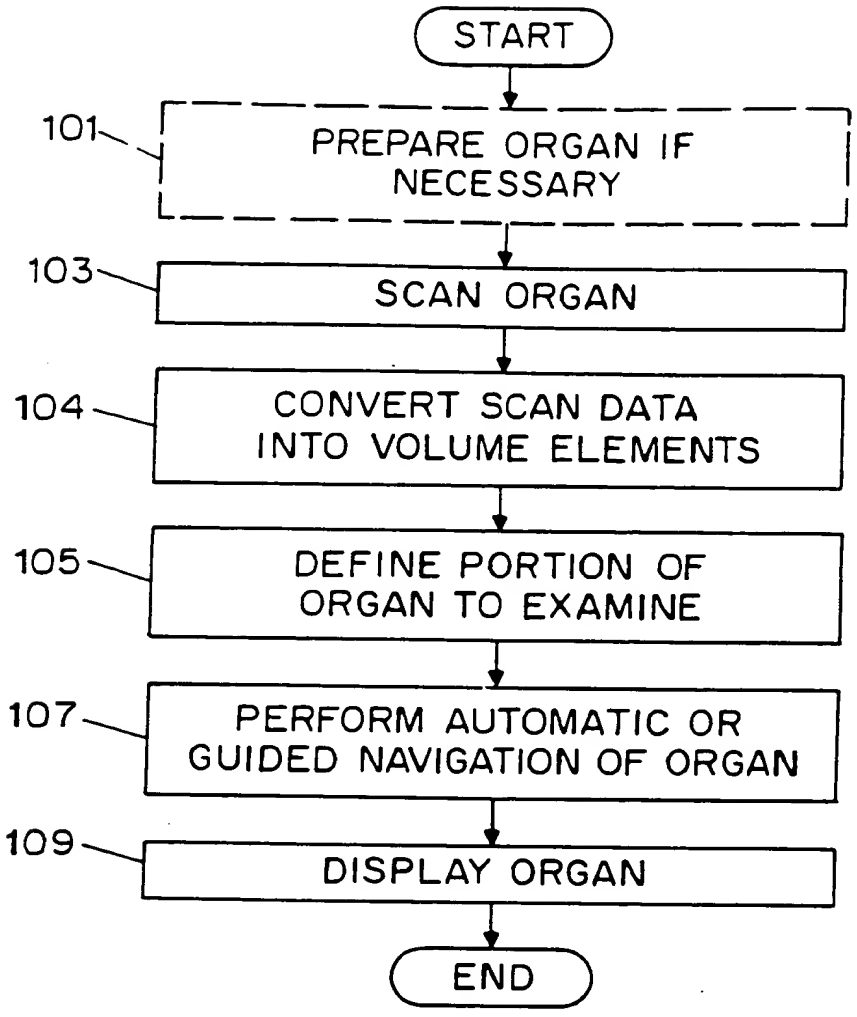

START
101
PREPARE ORGAN IF NECESSARY
103
SCAN ORGAN
104
CONVERT SCAN DATA INTO VOLUME ELEMENTS
105
DEFINE PORTION OF ORGAN TO EXAMINE
107
PERFORM AUTOMATIC OR GUIDED NAVIGATION OF ORGAN
109
DISPLAY ORGAN
END

FIG. 1

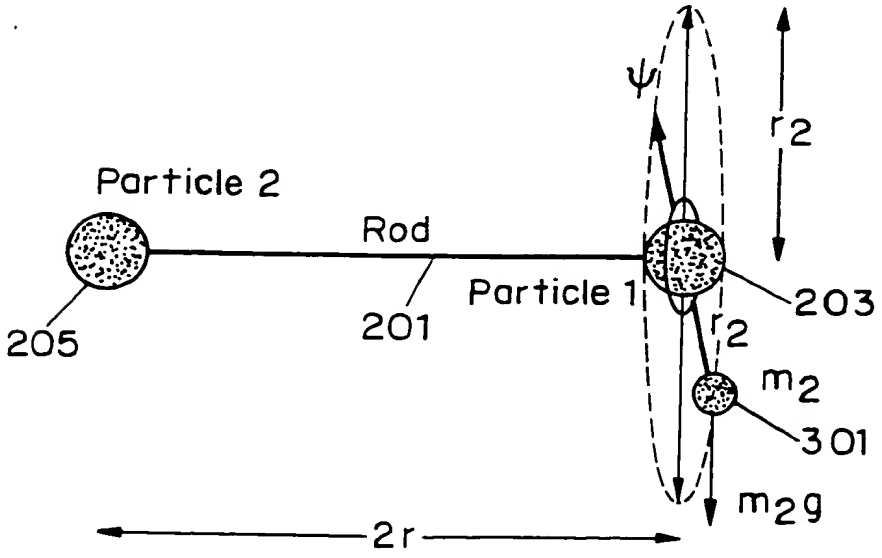

ψ
r2
Particle 2
Rod
Particle 1
203
205
201
r2
m2
301
m2g
2r

FIG. 3

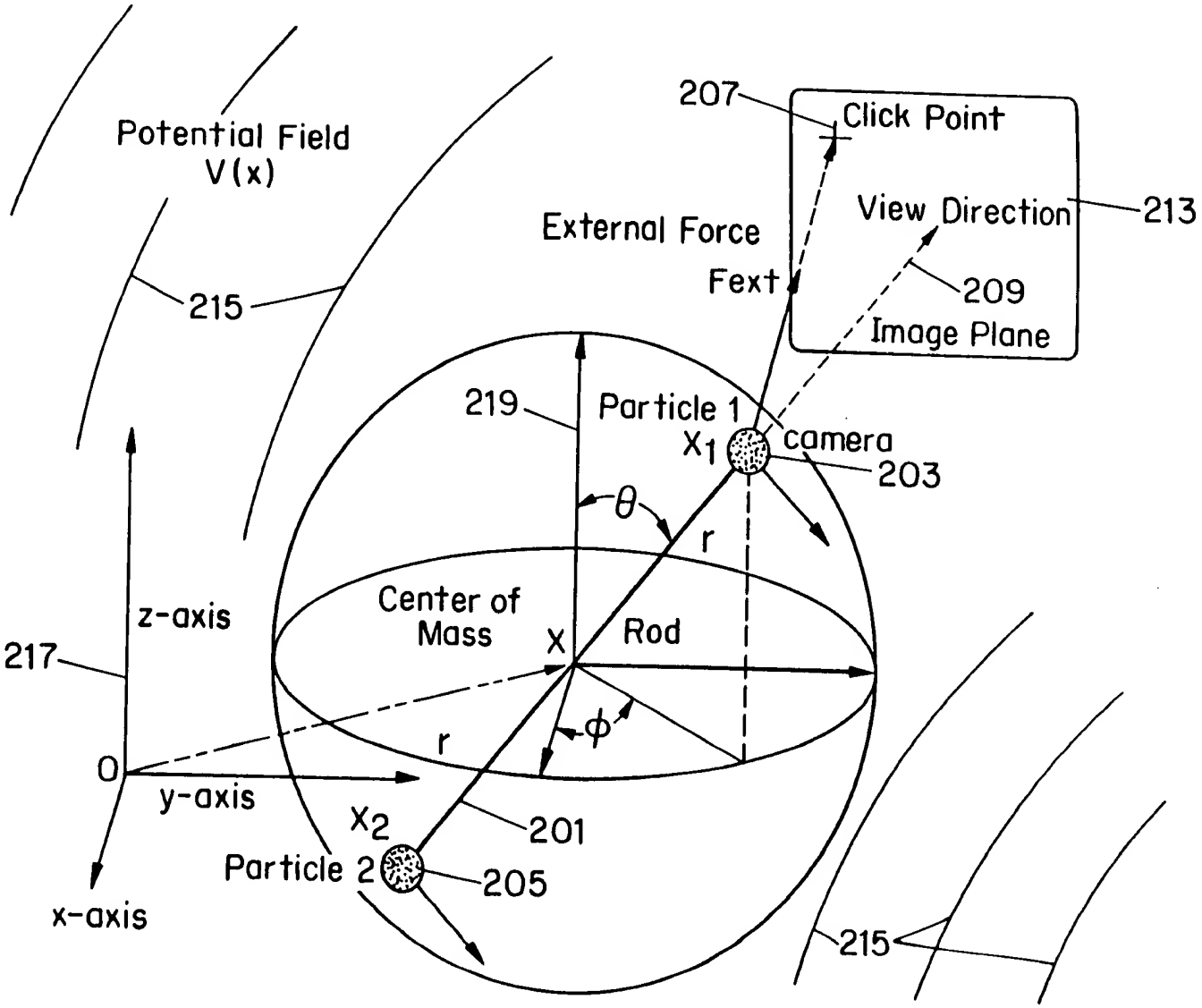

Potential Field
V(x)
215
207
Click Point
View Direction
213
External Force
Fext
209
Image Plane
219
Particle 1
X_1
camera
203
θ
r
Center of
Mass
X
Rod
217
z-axis
r
φ
0
y-axis
X_2
201
Particle 2
205
x-axis
215

FIG. 2

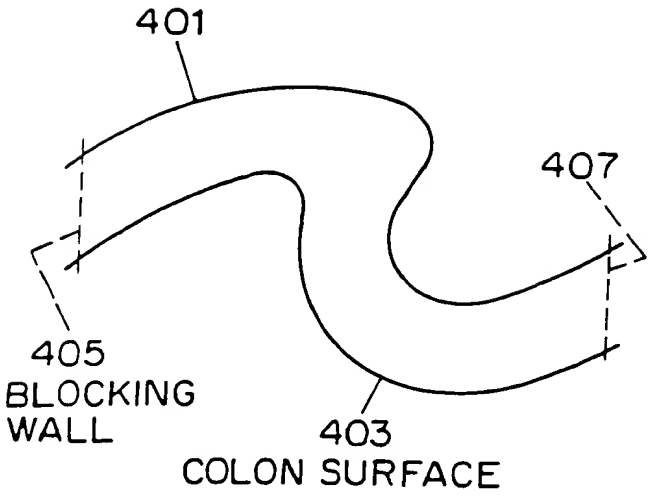


FIG. 4

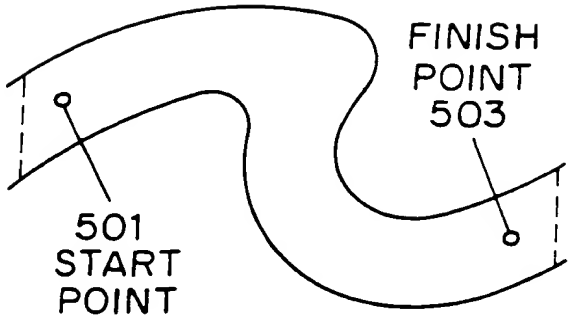


FIG. 5

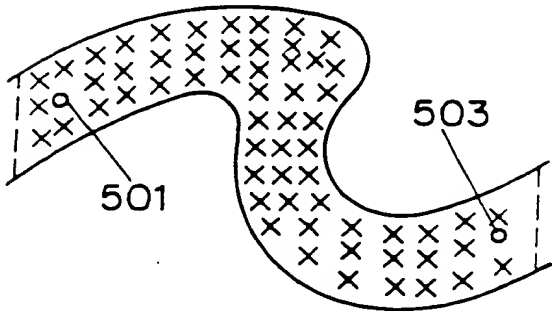


FIG. 6

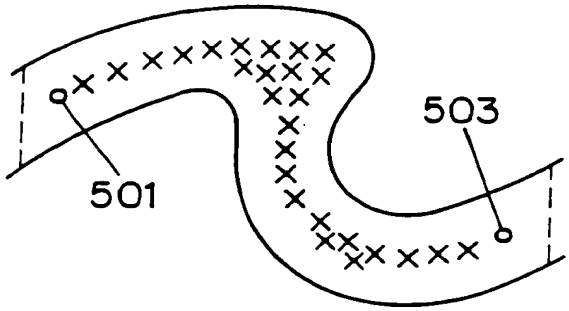


FIG. 7

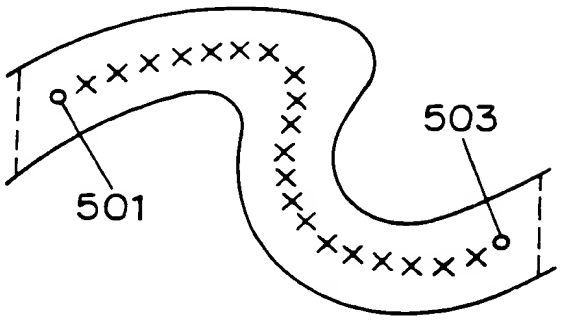


FIG. 8

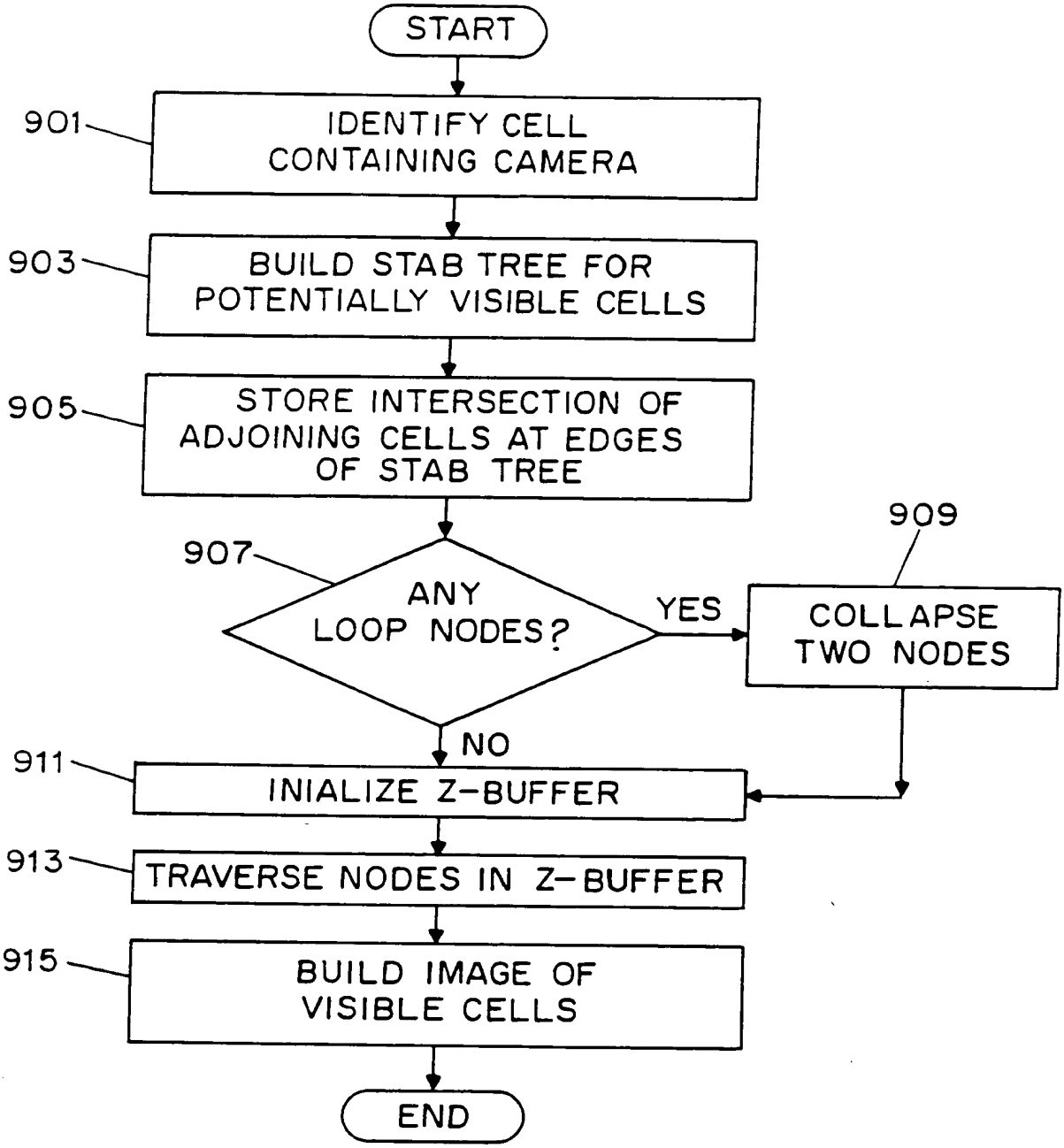

START
901
IDENTIFY CELL CONTAINING CAMERA
903
BUILD STAB TREE FOR POTENTIALLY VISIBLE CELLS
905
STORE INTERSECTION OF ADJOINING CELLS AT EDGES OF STAB TREE
907
ANY LOOP NODES?
YES
909
COLLAPSE TWO NODES
NO
911
INIALIZE Z-BUFFER
913
TRAVERSE NODES IN Z-BUFFER
915
BUILD IMAGE OF VISIBLE CELLS
END

FIG. 9

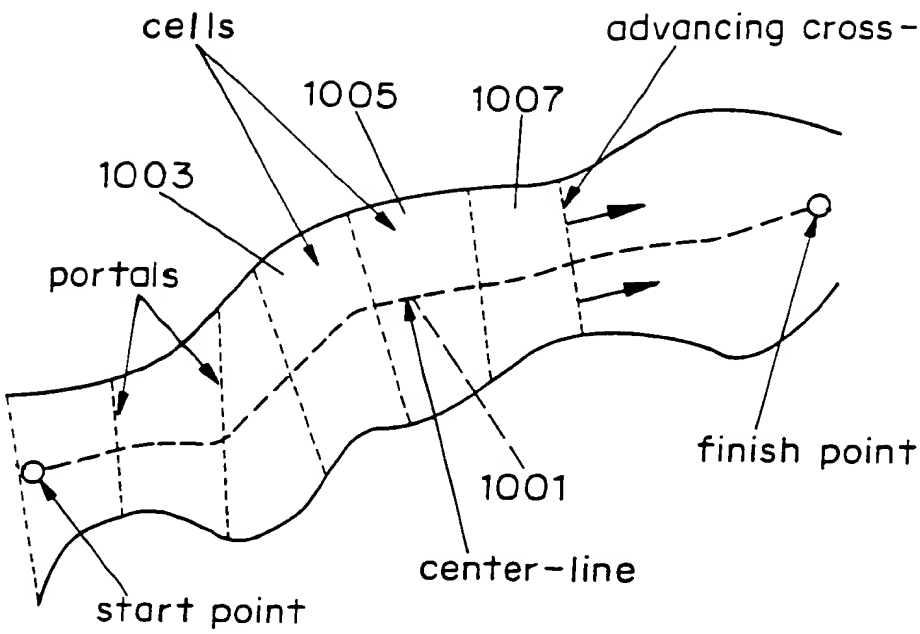


FIG. 10

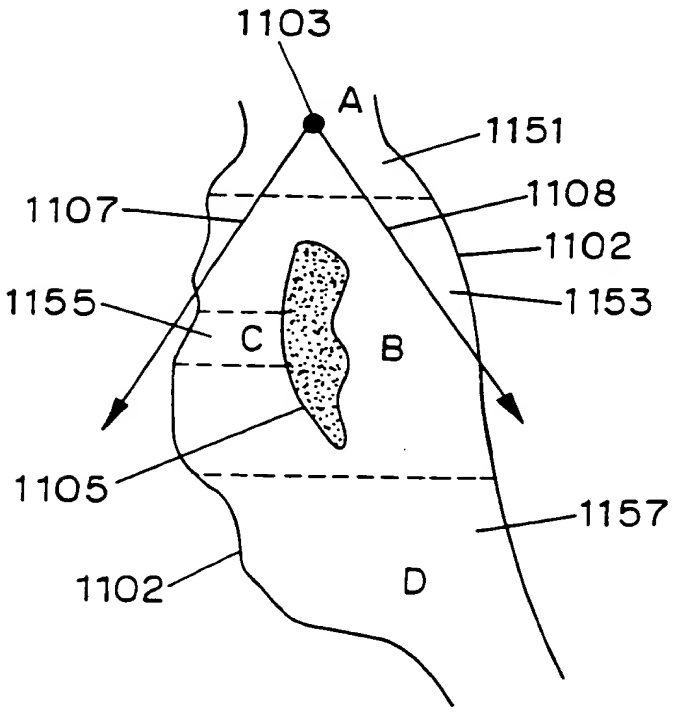


FIG. 11(a)

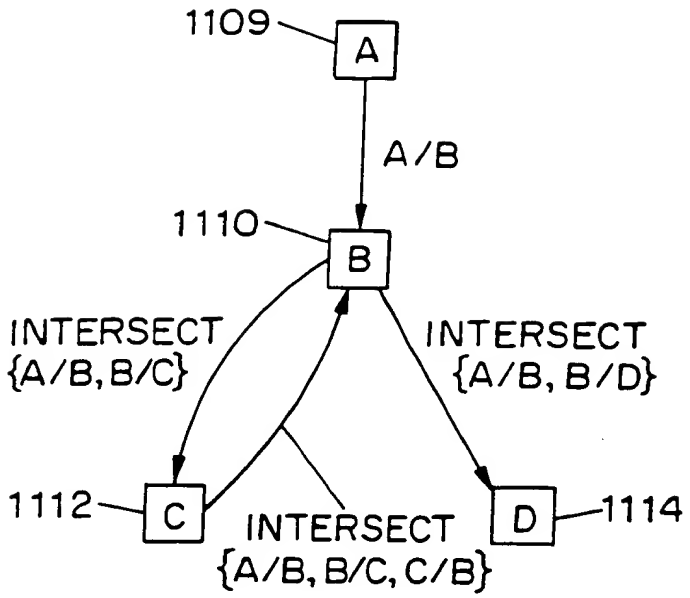


FIG. 11(b)

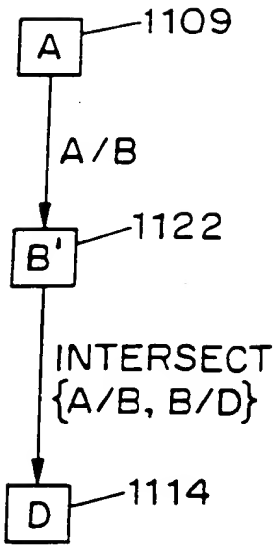


FIG. 11(c)

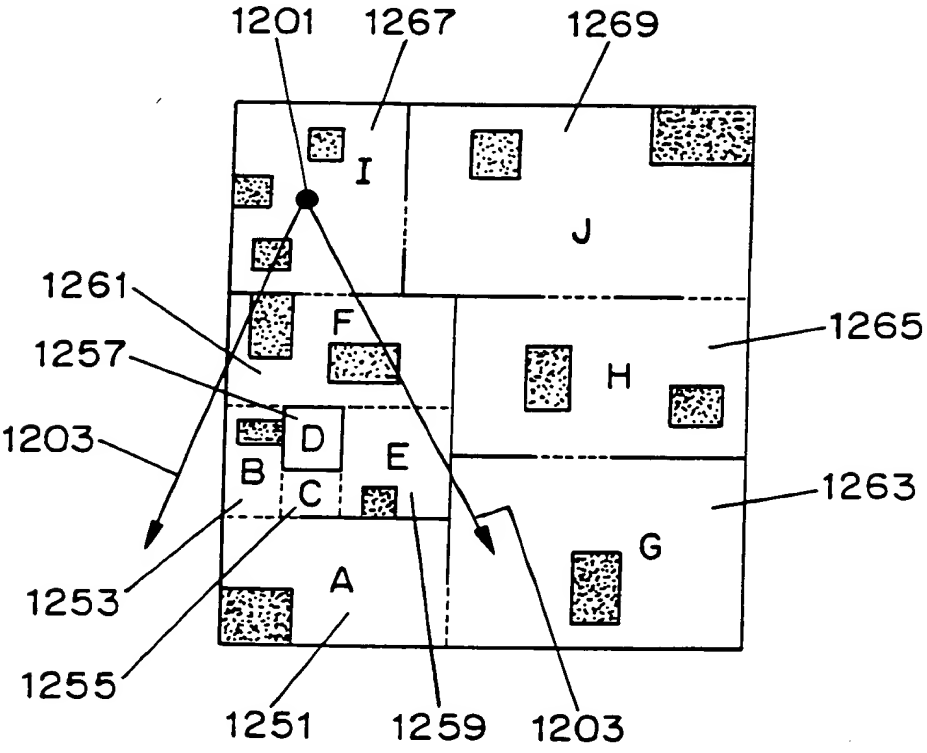


FIG. 12(a)

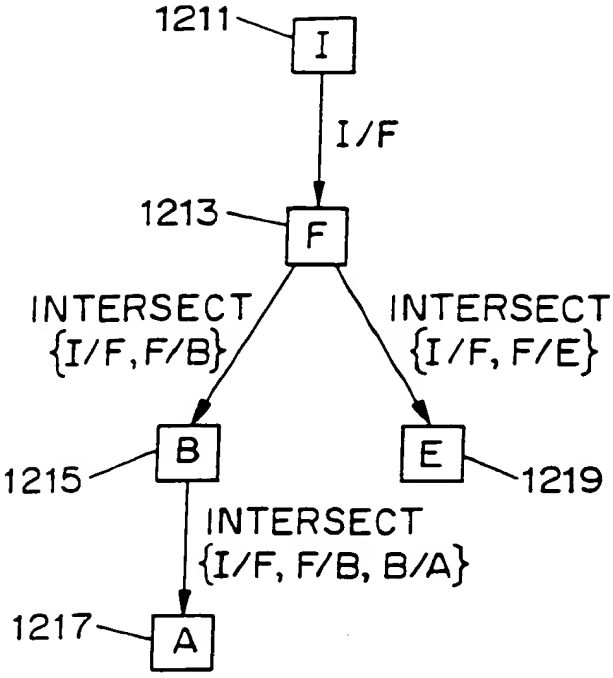


FIG. 12(b)

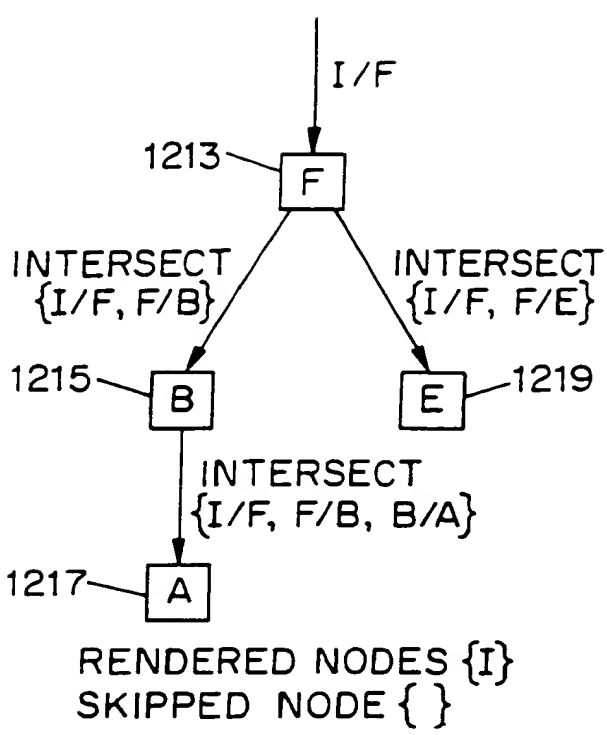


FIG. 12(c)

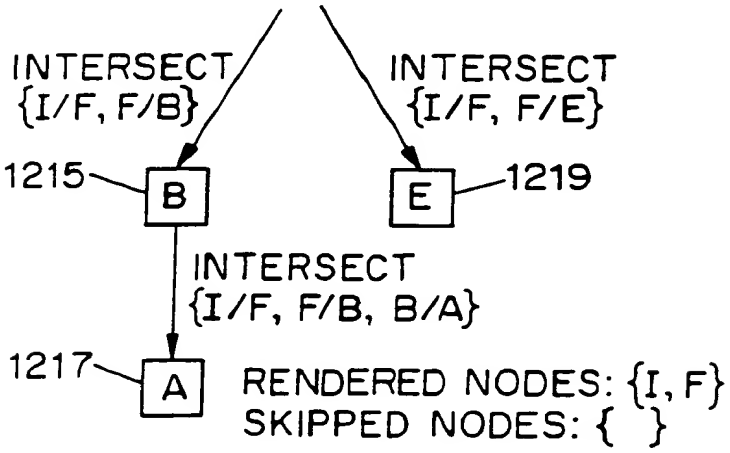


FIG. 12(d)

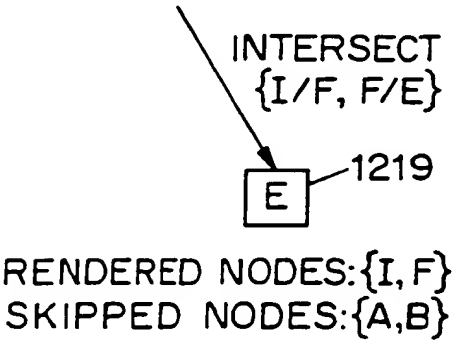


FIG. 12(e)

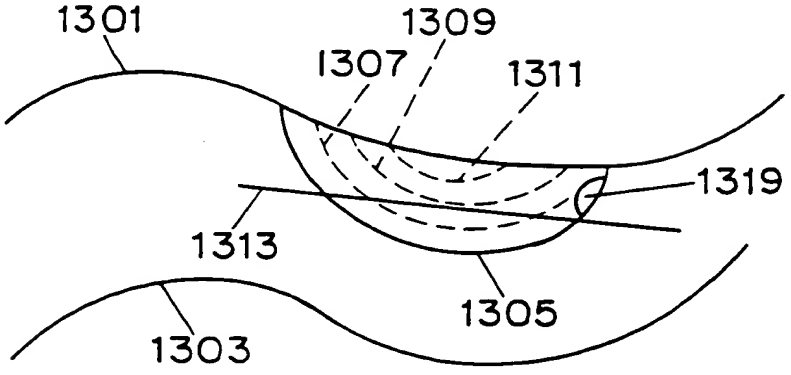


FIG. 13

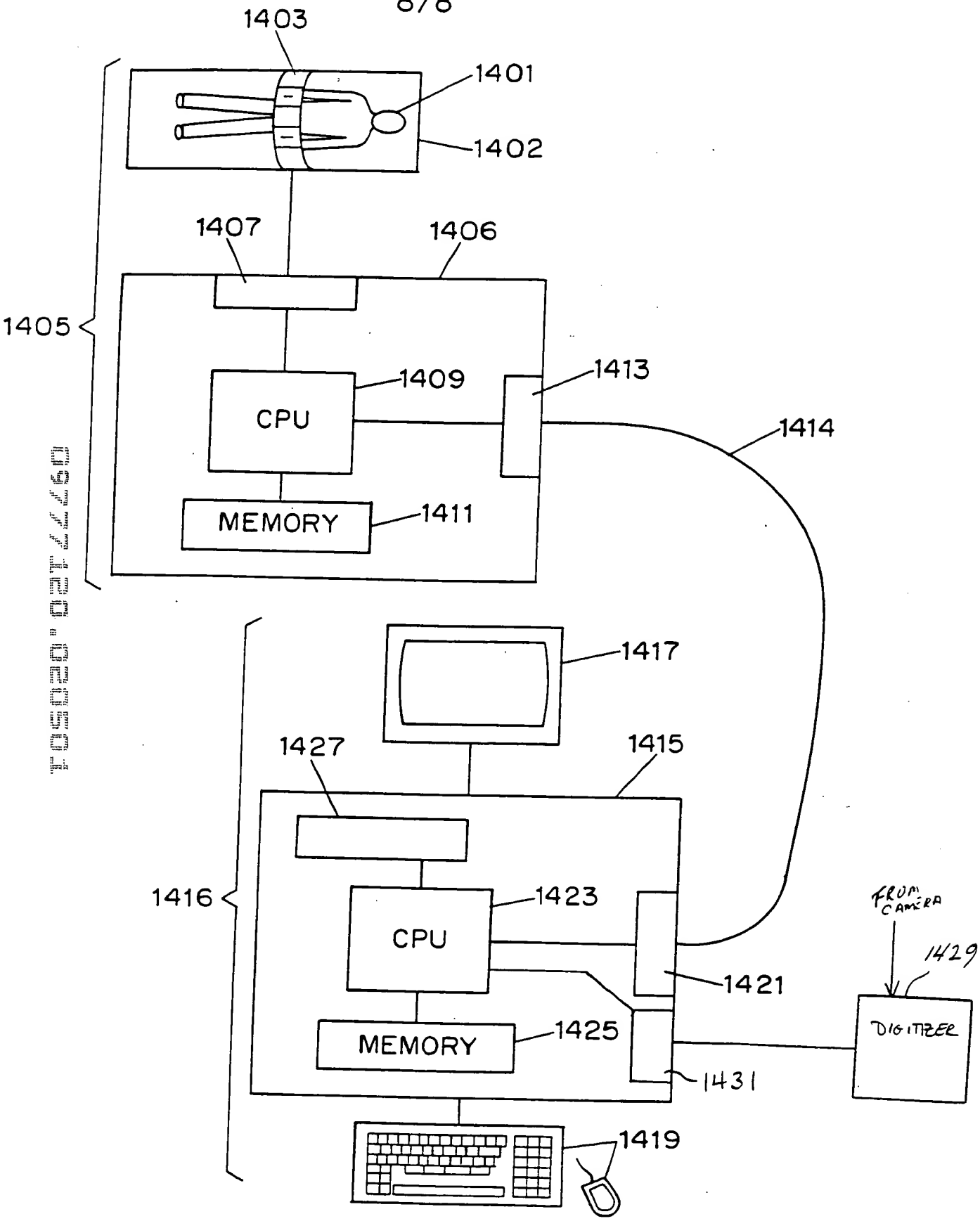
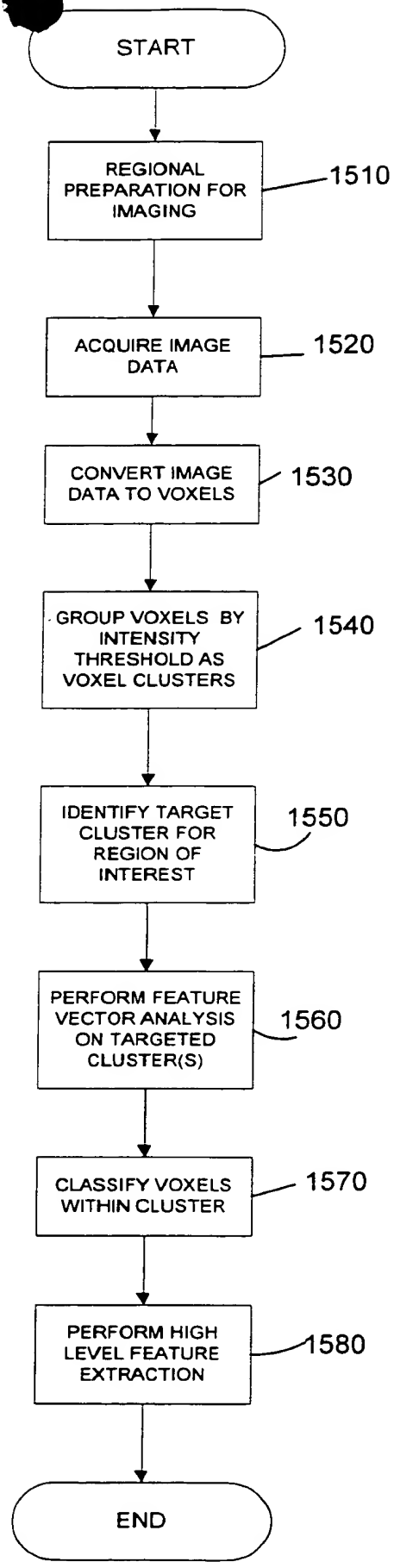

1403
1401
1402
1407
1406
1405
CPU
1409
1413
1414
MEMORY
1411
1417
1427
1415
1416
CPU
1423
FROM CAMERA
1429
1421
MEMORY
1425
DIGITIZER
1431
1419

FIG. 14

Fig. 15



Patent Application Publication

FIG. 16

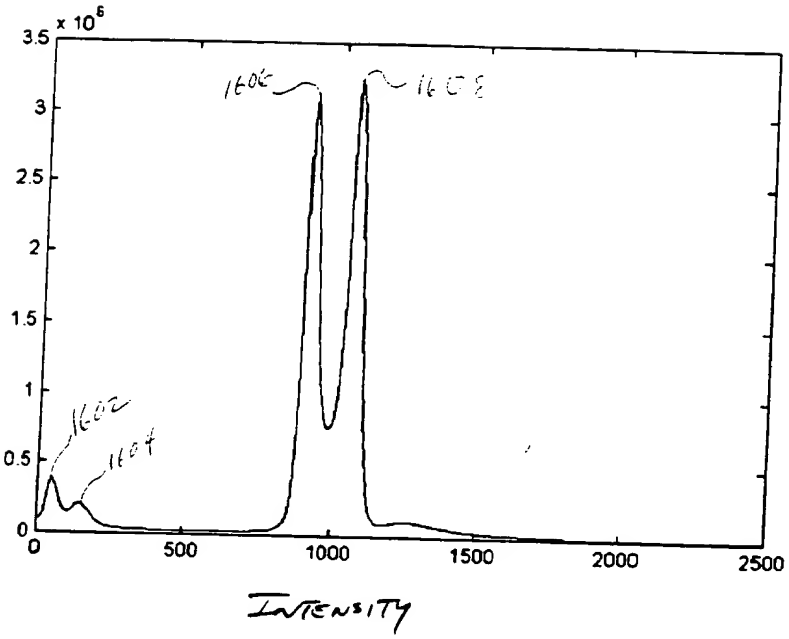

x 10^6
3.5
3
2.5
2
1.5
1
0.5
0
0
500
1000
1500
2000
2500
1606
1608
1602
1604
FREQUENCY
INTENSITY

FIG. 17

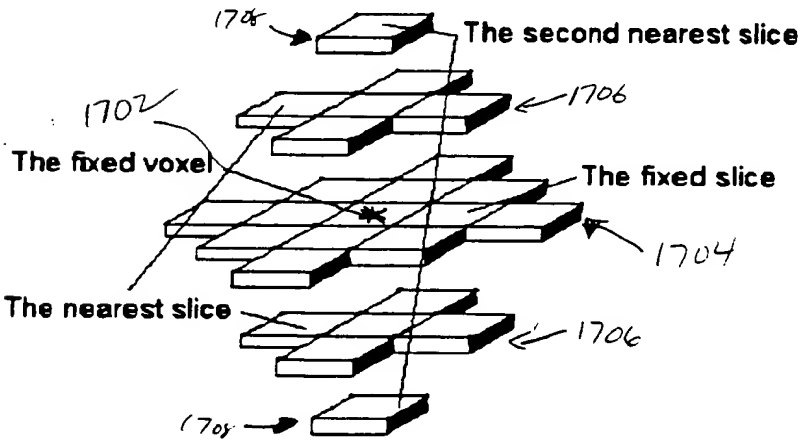

1705
The second nearest slice
1706
1702
The fixed voxel
The fixed slice
1704
The nearest slice
1706
1705

Fig 18A

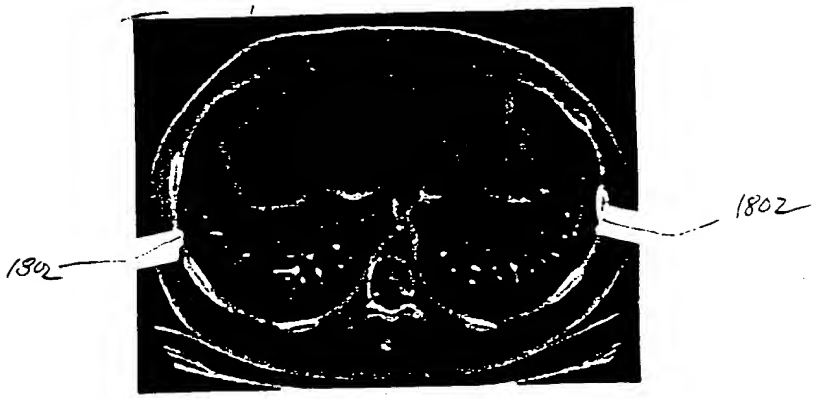


Fig 18B

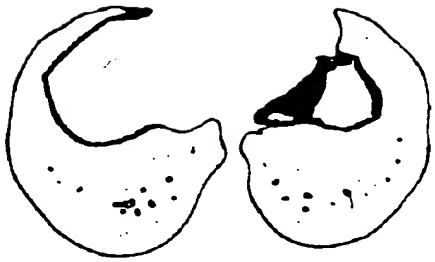
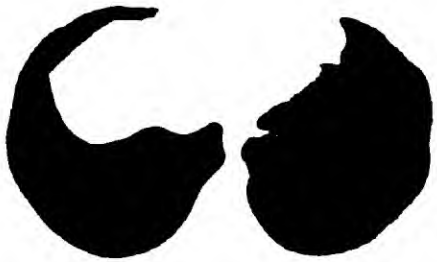


Fig. 18C



FOSSOBO" 05EZ/Z/E0

Fig 19A

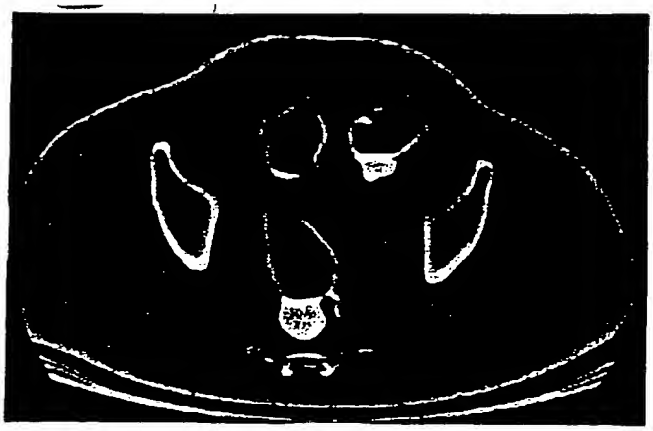


Fig. 19B

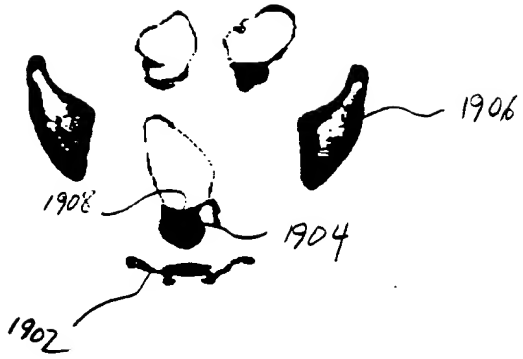


Fig 19C

FOSCAM-0027-0060

Fig. 20

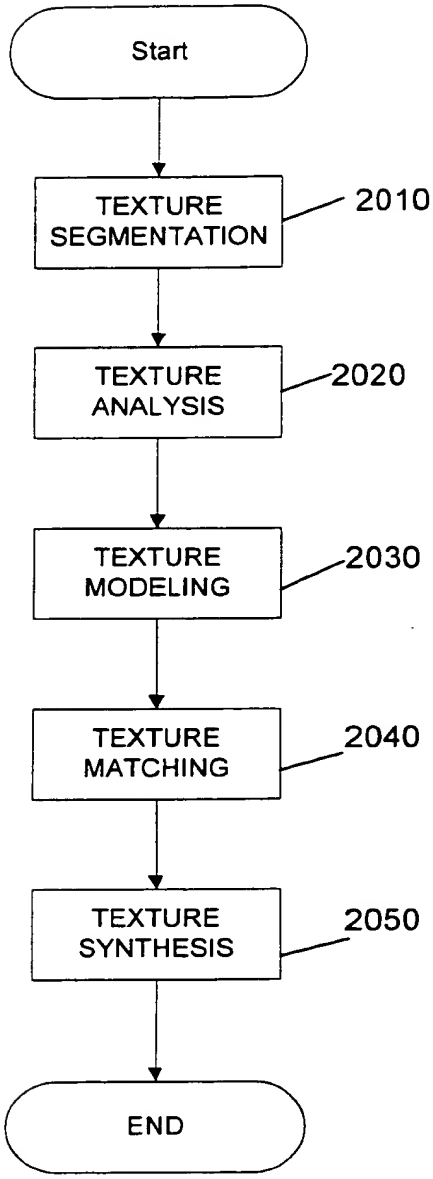

Start
TEXTURE SEGMENTATION
2010
TEXTURE ANALYSIS
2020
TEXTURE MODELING
2030
TEXTURE MATCHING
2040
TEXTURE SYNTHESIS
2050
END

FIG. 21

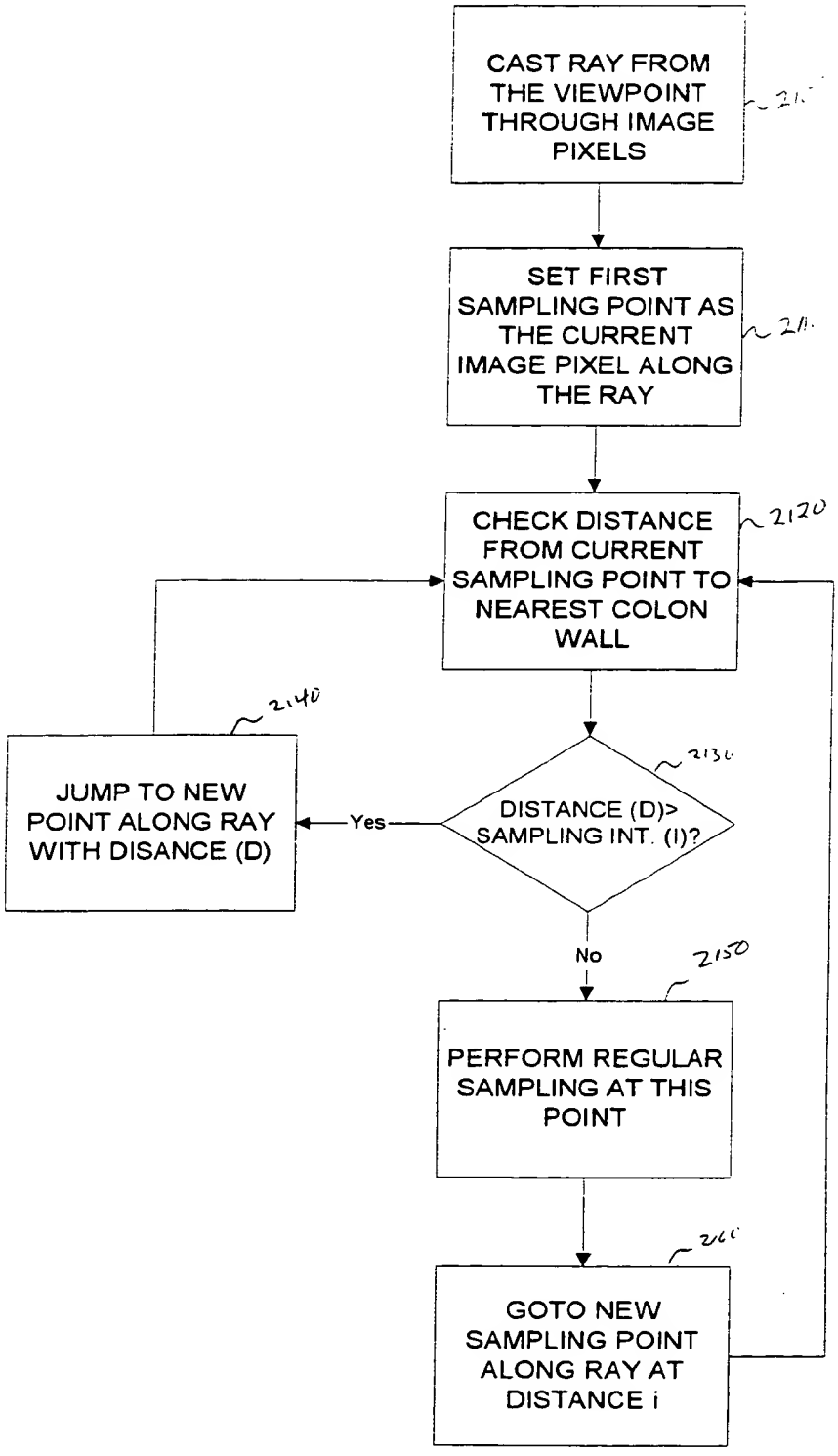

CAST RAY FROM THE VIEWPOINT THROUGH IMAGE PIXELS
SET FIRST SAMPLING POINT AS THE CURRENT IMAGE PIXEL ALONG THE RAY
CHECK DISTANCE FROM CURRENT SAMPLING POINT TO NEAREST COLON WALL
2120
DISTANCE (D)> SAMPLING INT. (I)?
2130
Yes
JUMP TO NEW POINT ALONG RAY WITH DISANCE (D)
2140
No
PERFORM REGULAR SAMPLING AT THIS POINT
2150
GOTO NEW SAMPLING POINT ALONG RAY AT DISTANCE i

FIG. 22

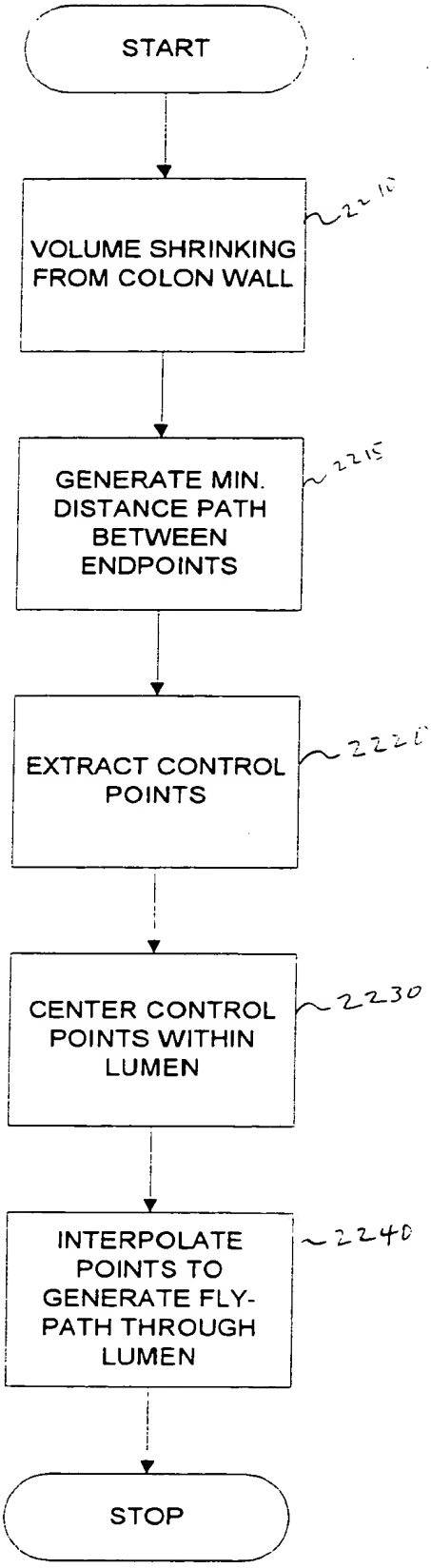

START
VOLUME SHRINKING FROM COLON WALL
2210
GENERATE MIN. DISTANCE PATH BETWEEN ENDPOINTS
2215
EXTRACT CONTROL POINTS
2220
CENTER CONTROL POINTS WITHIN LUMEN
2230
INTERPOLATE POINTS TO GENERATE FLY-PATH THROUGH LUMEN
2240
STOP

FIG. 23

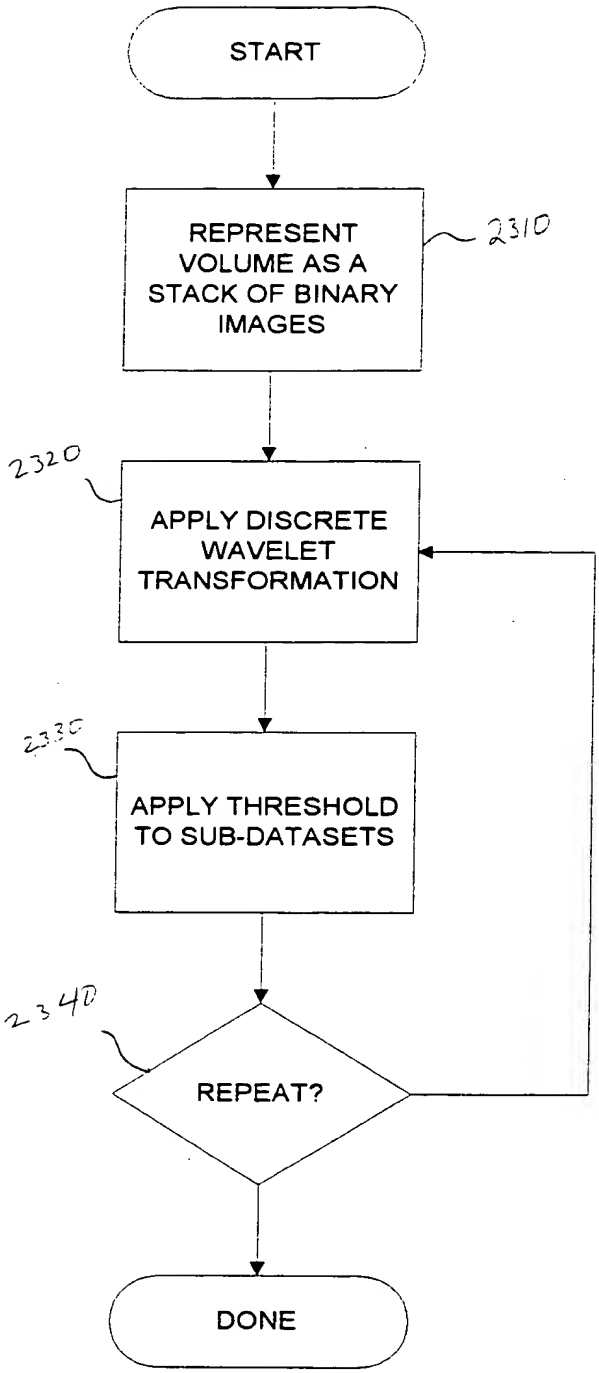

START
REPRESENT VOLUME AS A STACK OF BINARY IMAGES
2310
2320
APPLY DISCRETE WAVELET TRANSFORMATION
2330
APPLY THRESHOLD TO SUB-DATASETS
2340
REPEAT?
DONE

FIG 24

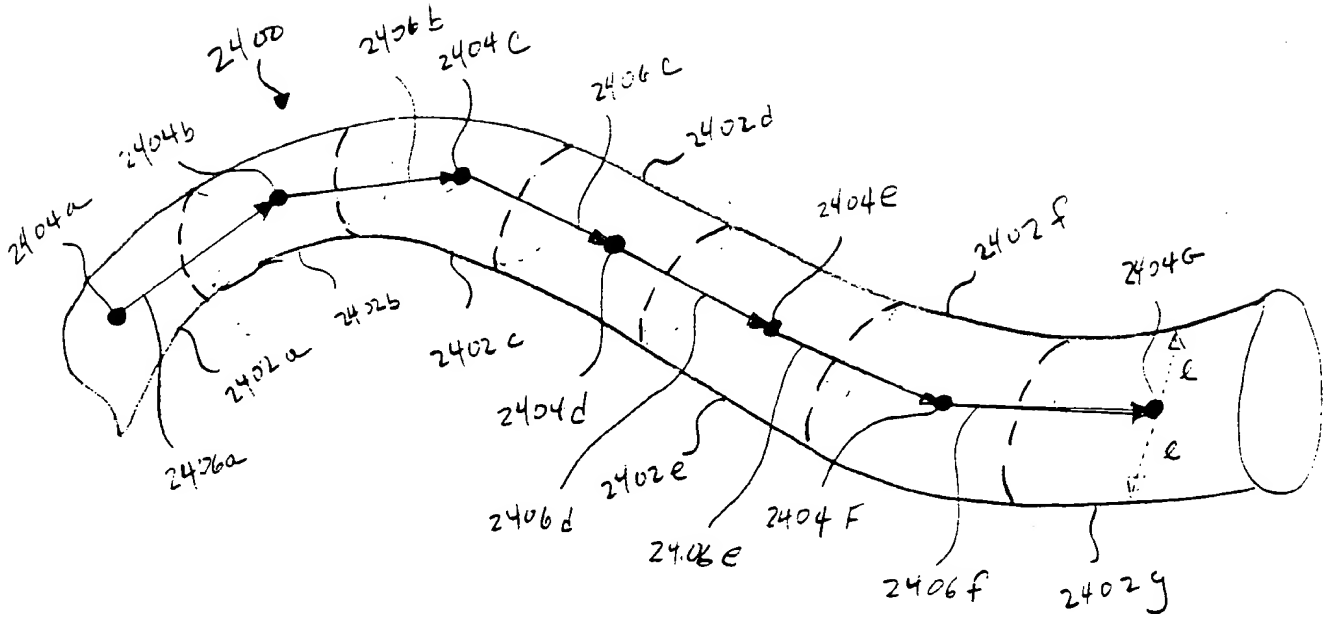

2400
2406b
2404c
2406c
2402d
2404b
2404a
2404e
2402f
2404G
2402b
2402c
2402a
2404d
2406a
2406d
2402e
2404F
2406e
2406f
2402g

FIG. 25

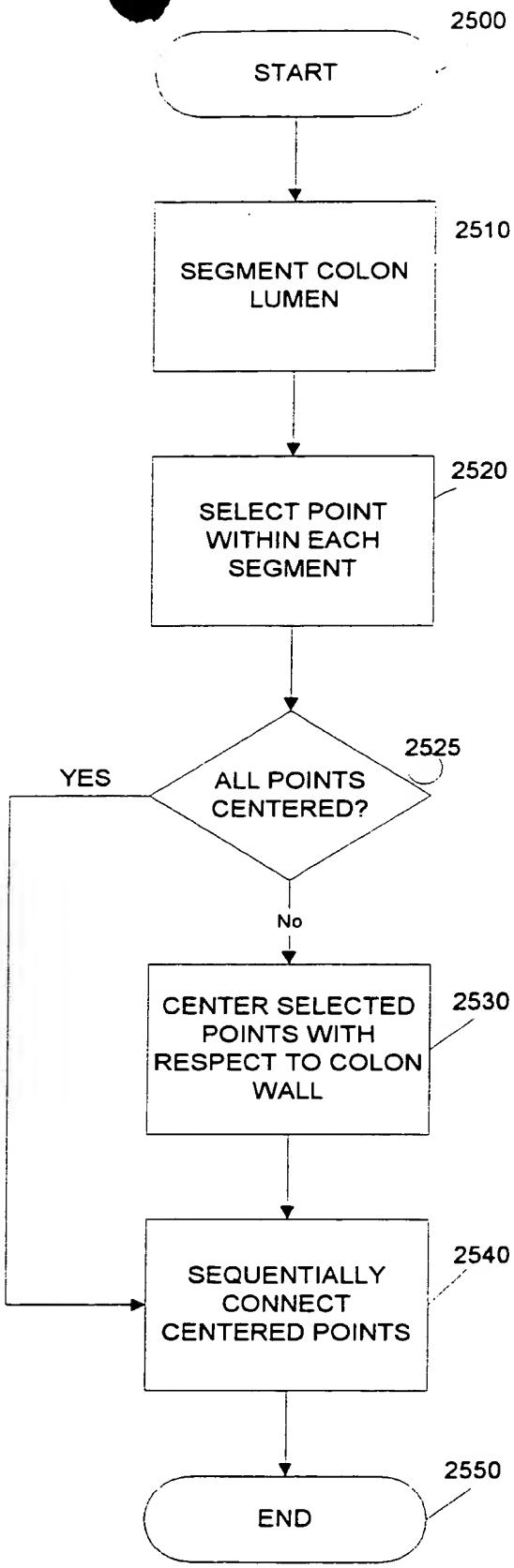

2500
START
SEGMENT COLON LUMEN
2510
SELECT POINT WITHIN EACH SEGMENT
2520
ALL POINTS CENTERED?
2525
YES
No
CENTER SELECTED POINTS WITH RESPECT TO COLON WALL
2530
SEQUENTIALLY CONNECT CENTERED POINTS
2540
END
2550

FIG 26

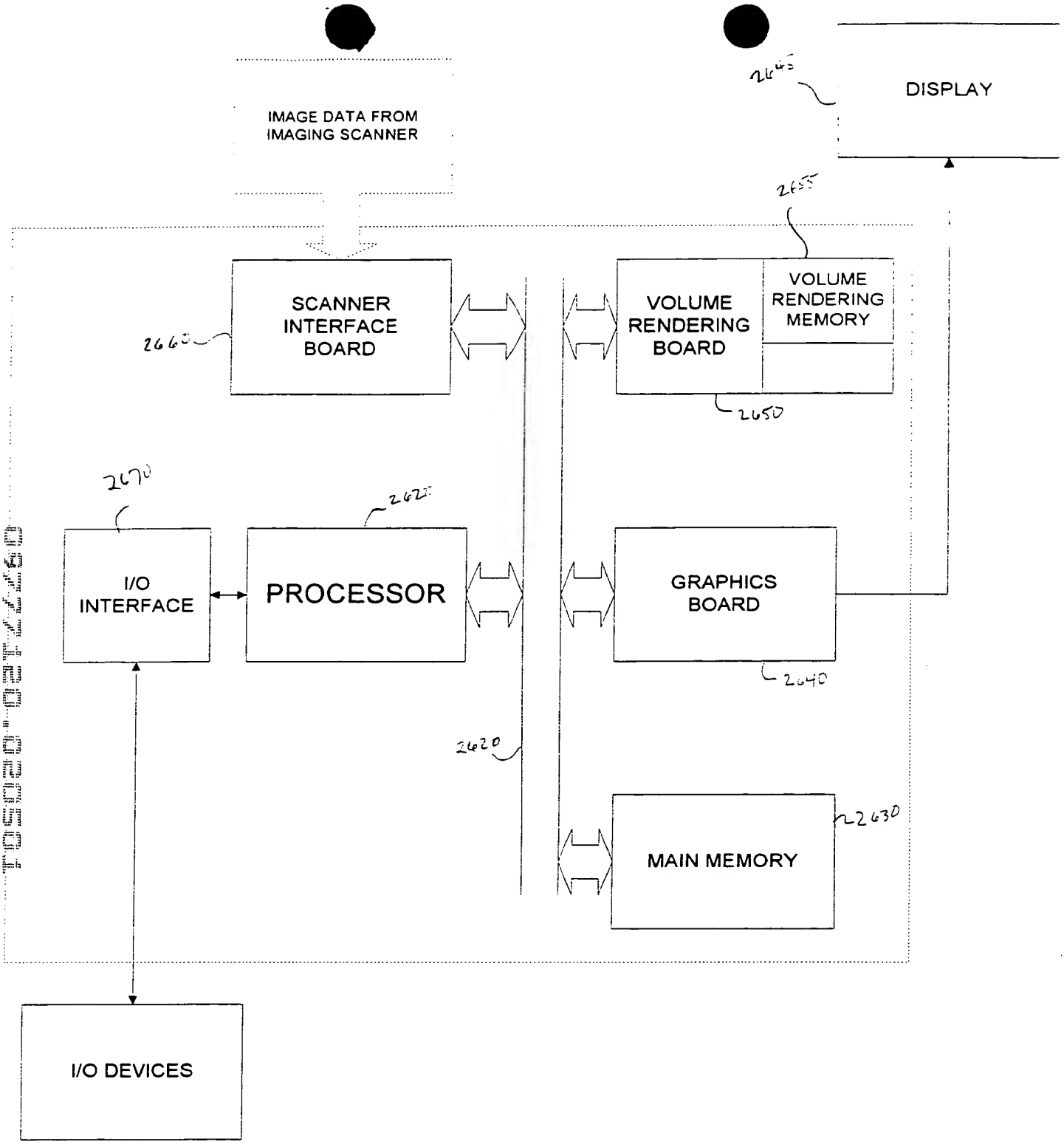


IMAGE DATA FROM IMAGING SCANNER
DISPLAY
2645
2655
SCANNER INTERFACE BOARD
2660
VOLUME RENDERING BOARD
VOLUME RENDERING MEMORY
2650
2670
2625
I/O INTERFACE
PROCESSOR
GRAPHICS BOARD
2640
2620
MAIN MEMORY
2630
I/O DEVICES

FIG. 27

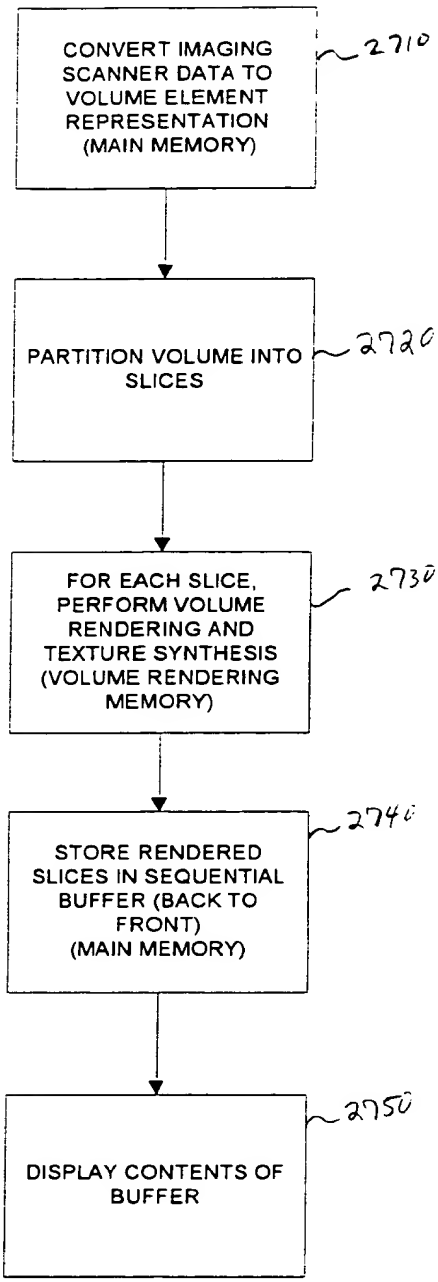

CONVERT IMAGING SCANNER DATA TO VOLUME ELEMENT REPRESENTATION (MAIN MEMORY)
2710
PARTITION VOLUME INTO SLICES
2720
FOR EACH SLICE, PERFORM VOLUME RENDERING AND TEXTURE SYNTHESIS (VOLUME RENDERING MEMORY)
2730
STORE RENDERED SLICES IN SEQUENTIAL BUFFER (BACK TO FRONT) (MAIN MEMORY)
2740
DISPLAY CONTENTS OF BUFFER
2750

FIG. 28

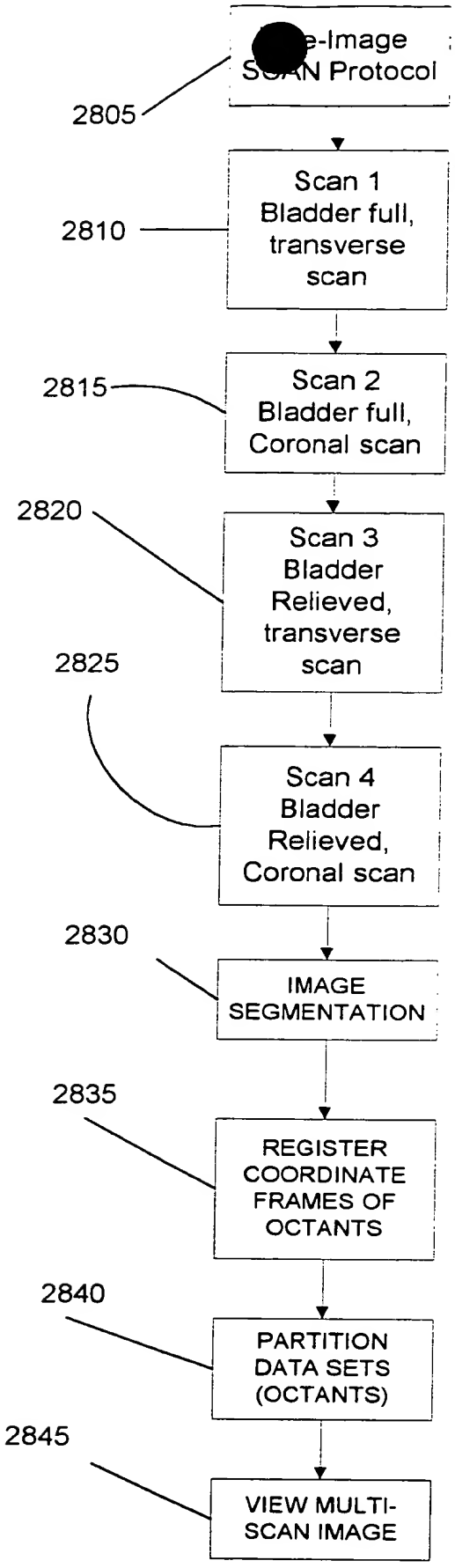
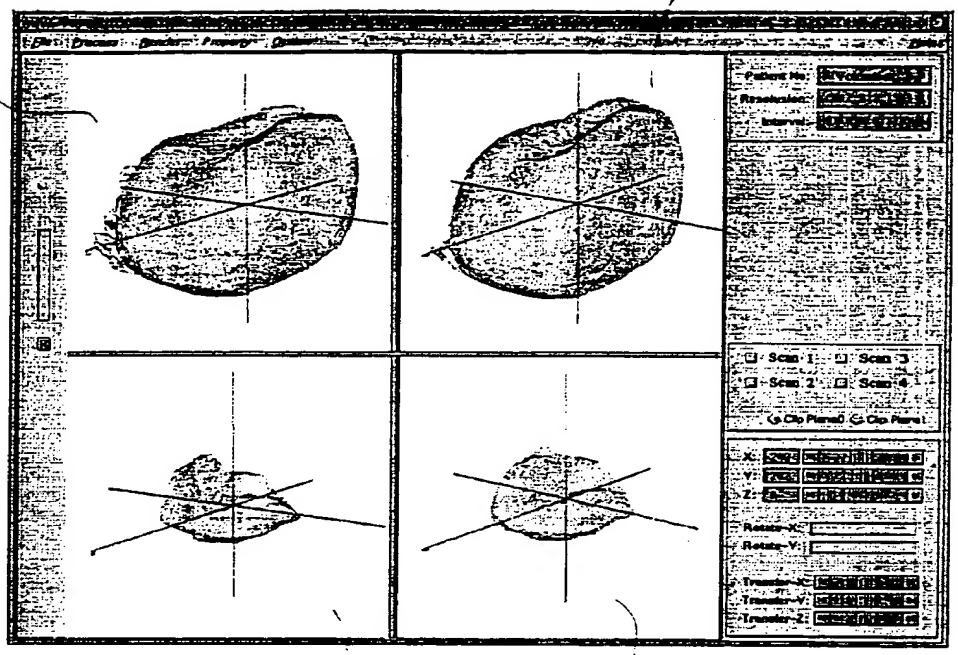

e-Image
SCAN Protocol
2805
Scan 1
Bladder full,
transverse
scan
2810
Scan 2
Bladder full,
Coronal scan
2815
Scan 3
Bladder
Relieved,
transverse
scan
2820
Scan 4
Bladder
Relieved,
Coronal scan
2825
2830
IMAGE
SEGMENTATION
2835
REGISTER
COORDINATE
FRAMES OF
OCTANTS
2840
PARTITION
DATA SETS
(OCTANTS)
2845
VIEW MULTI-
SCAN IMAGE

Fig. 29


2910
2925
2915
2935
2920

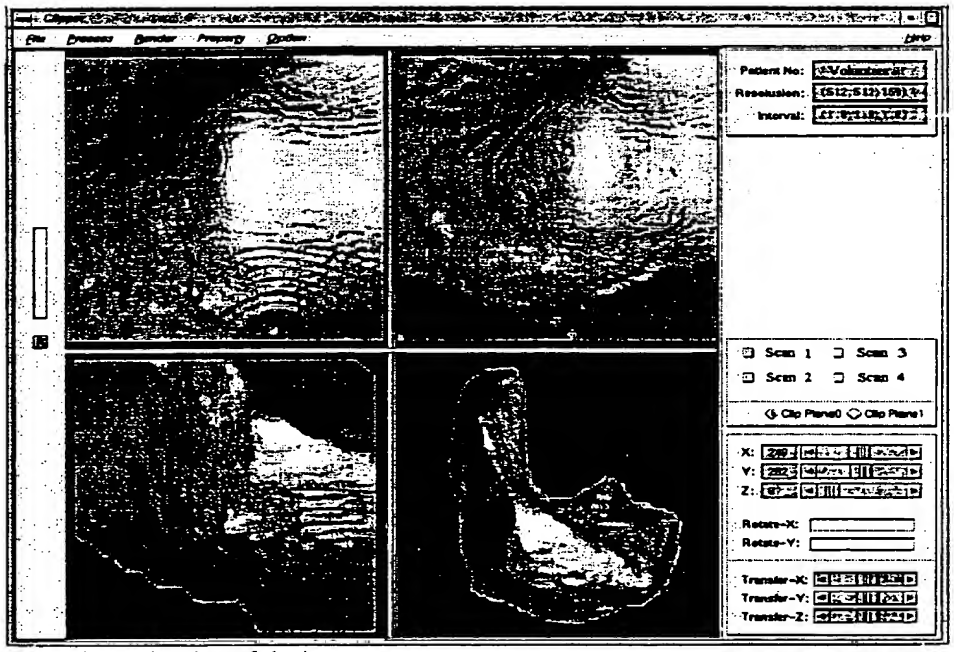

Patient No:
Resolution:
Interval:
Scan 1
Scan 3
Scan 2
Scan 4
Clip Plane0
Clip Plane1
X:
Y:
Z:
Rotate-X:
Rotate-Y:
Translate-X:
Translate-Y:
Translate-Z:

Fig. 30

FIG. 31

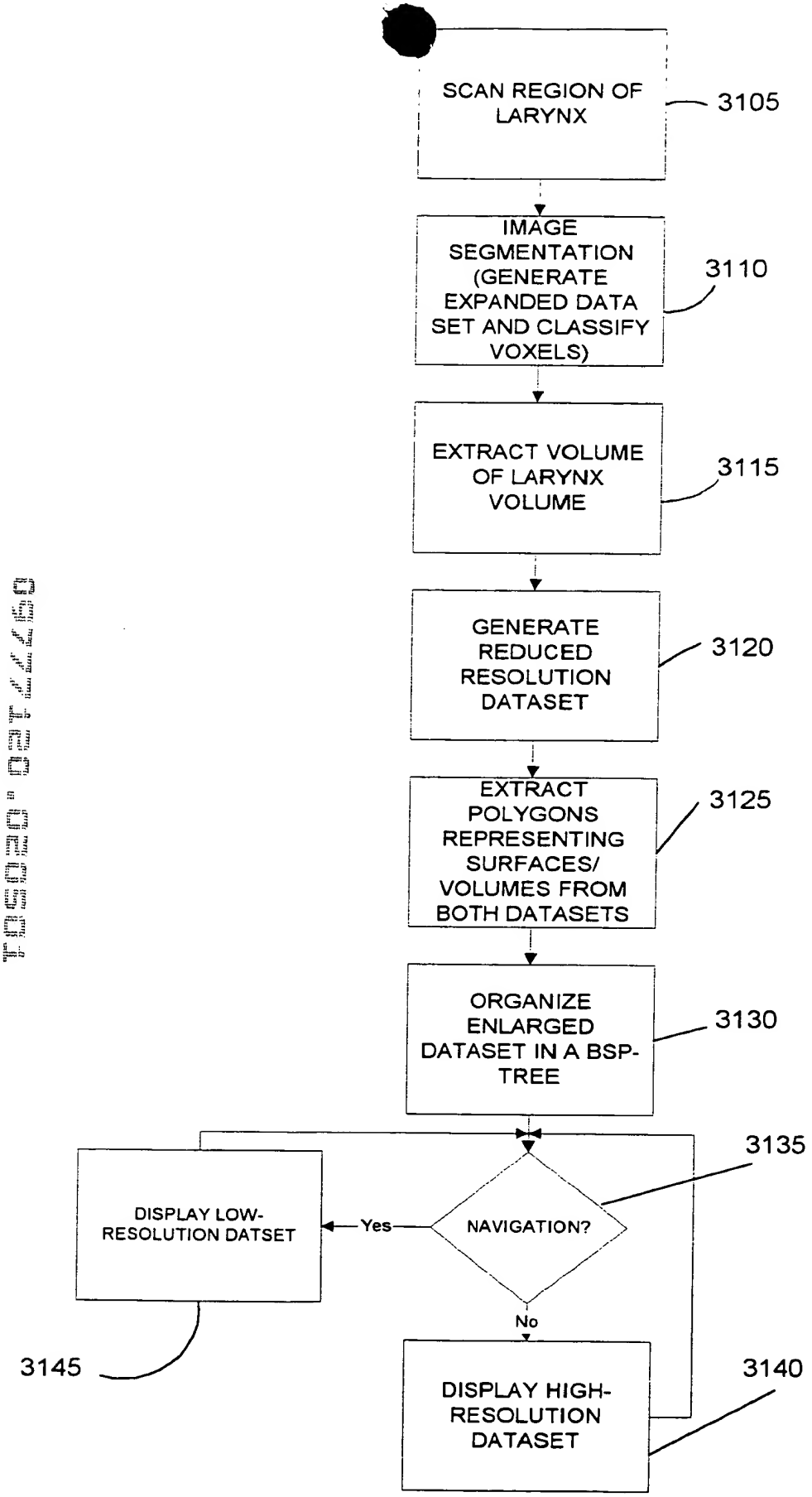
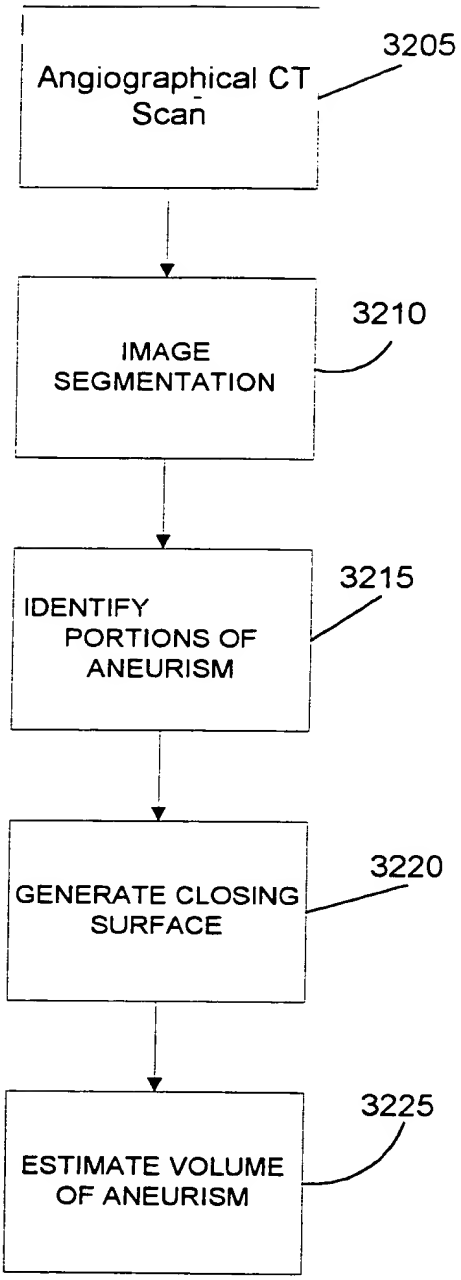

SCAN REGION OF LARYNX
3105
IMAGE SEGMENTATION (GENERATE EXPANDED DATA SET AND CLASSIFY VOXELS)
3110
EXTRACT VOLUME OF LARYNX VOLUME
3115
GENERATE REDUCED RESOLUTION DATASET
3120
EXTRACT POLYGONS REPRESENTING SURFACES/ VOLUMES FROM BOTH DATASETS
3125
ORGANIZE ENLARGED DATASET IN A BSP-TREE
3130
3135
NAVIGATION?
Yes
No
DISPLAY LOW-RESOLUTION DATSET
3145
DISPLAY HIGH-RESOLUTION DATASET
3140

FIG. 32


Angiographical CT Scan
3205
IMAGE SEGMENTATION
3210
IDENTIFY PORTIONS OF ANEURISM
3215
GENERATE CLOSING SURFACE
3220
ESTIMATE VOLUME OF ANEURISM
3225

3A

FIG. 3B

FIG. 3C

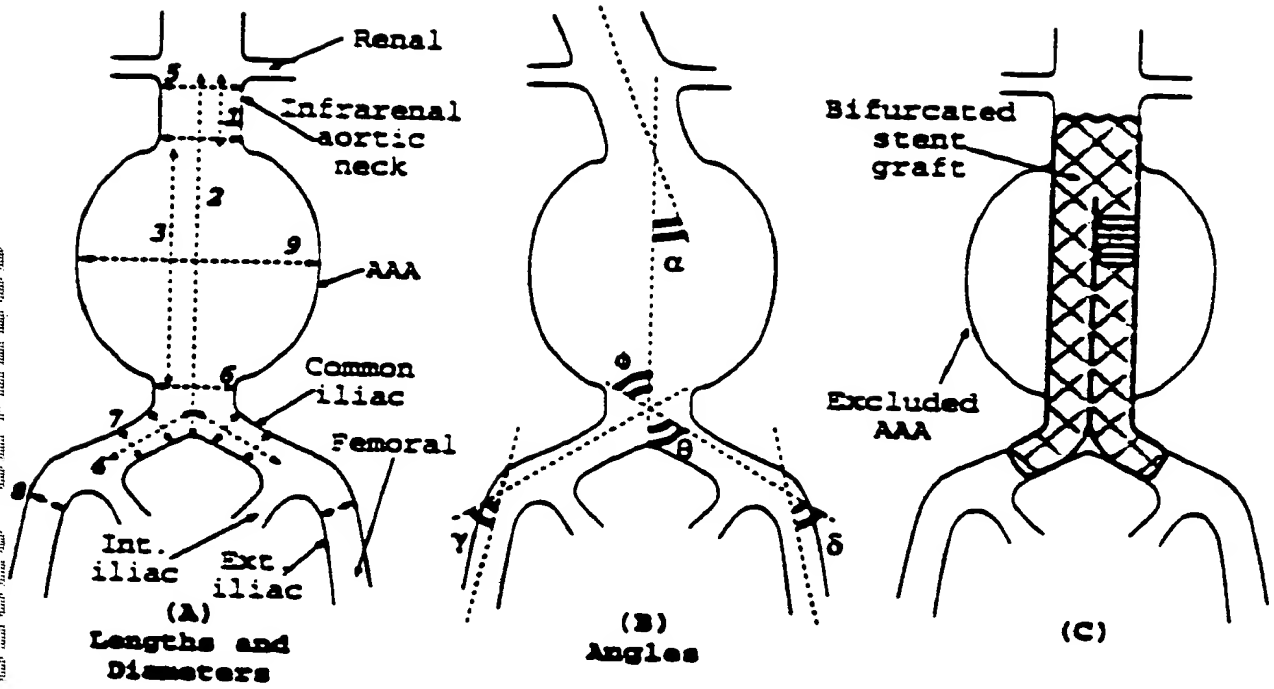


FIG.

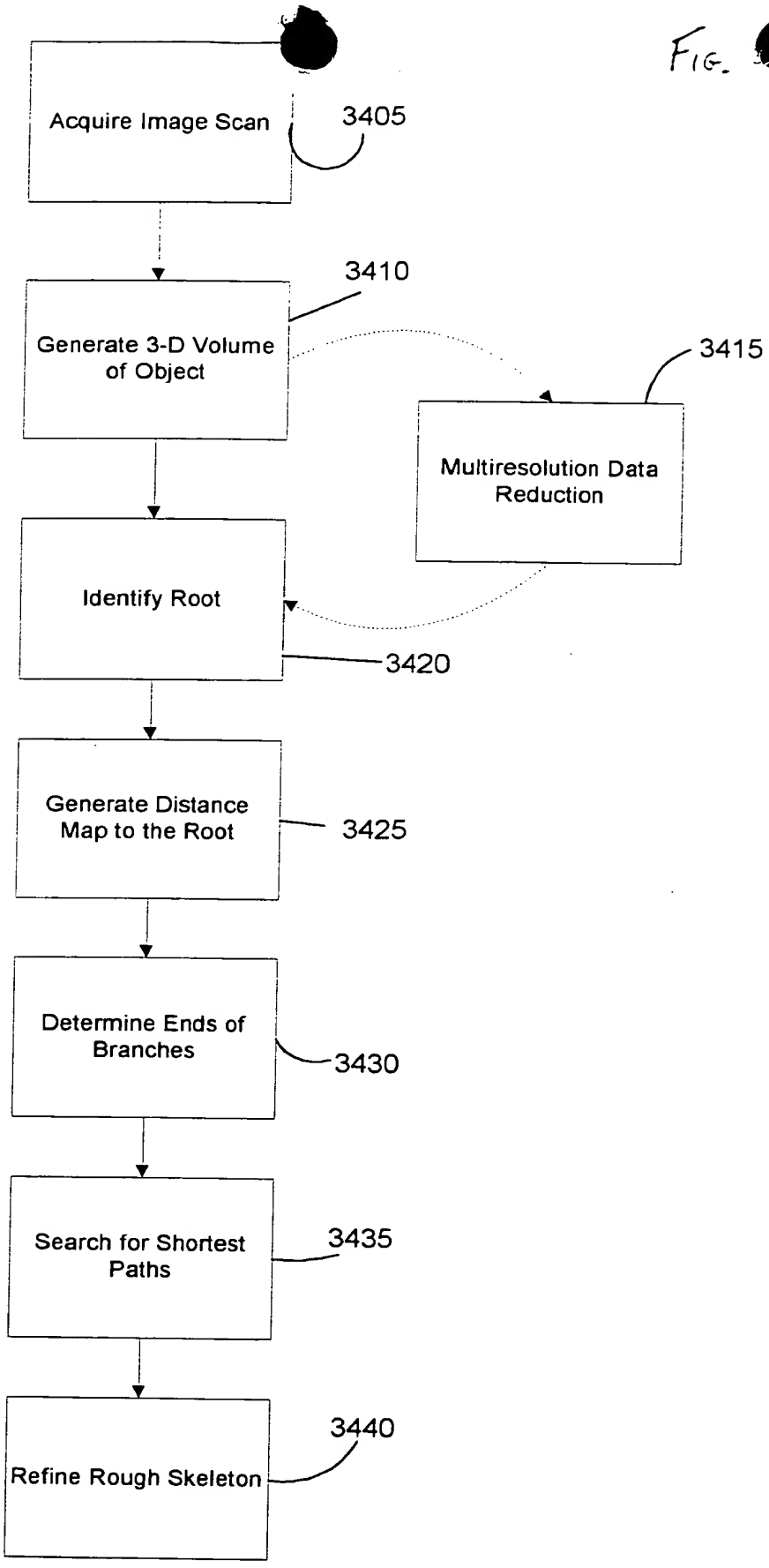

Acquire Image Scan
3405
Generate 3-D Volume of Object
3410
Multiresolution Data Reduction
3415
Identify Root
3420
Generate Distance Map to the Root
3425
Determine Ends of Branches
3430
Search for Shortest Paths
3435
Refine Rough Skeleton
3440

FIG. 35

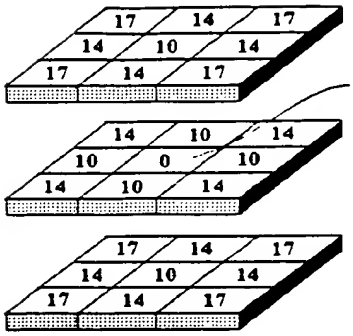


FIG. 36

1) Label root voxel with integer 0;
2) Construct a queue and line up the root in the queue;
3) **If**(There is at least one voxel in the queue)
   Serve the voxel **x** on the top of the queue:
   For(each of **x**'s 26-connected neighbor voxel **y**) {
   If(**y** in the volume and has not been labeled yet) {
   Line up the **y** in the queue;

   /* label the voxel **y** */
   Set $dist = 999999$;
   For(each of **y**'s 26-connected neighbor voxel **z**) {
   If(**z** in the volume and has been already labeled with an integer of n_z) {
   $d_z \equiv n_z + d(y,z)$;
   where $d(y,z)$ is 10, 14 or 17 if the Euclidean distance between **y** and **z** is
   $1, \sqrt{2}$, or $\sqrt{3}$, respectively;
   }
   If($dist > d_z$) {
   label **y** with integer $dist$;
   $dist = d_z$;
   }
   }
   }
   }
   x leaves the queue;
   }
   Else {
   end of calculating the distance map.
   }